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Laboratory Studies of Heterogeneous Chemistry Important in the Atmosphere

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Abstract

In this talk I will present a review of recent laboratory data on the heterogeneous chemistry of importance in the atmosphere. The experimental results have been obtained at the Jet Propulsion Laboratory and elsewhere. Heterogeneous processes are thought to play an important role in the stratospheric ozone depletion by chlorofluorocarbons, the atmsopheric effects of volcanic eruptions such as Mt. Pinatubo or El Chichon, the emissions of high-speed civil aircrafts, and the recently discovered arctic tropospheric ozone loss. Several of these processes will be discussed as follows:

1) The uptake of hydrogen chloride in both water ice and nitric acid trihydrate,

2) Heterogeneous reactions of chlorine nitrate with water molecule and hydrogen chloride in both water ice and nitric acid trihydrate,

3) Heterogenous reactions of chlorine nitrate and nitric acid vapor with salt particles.

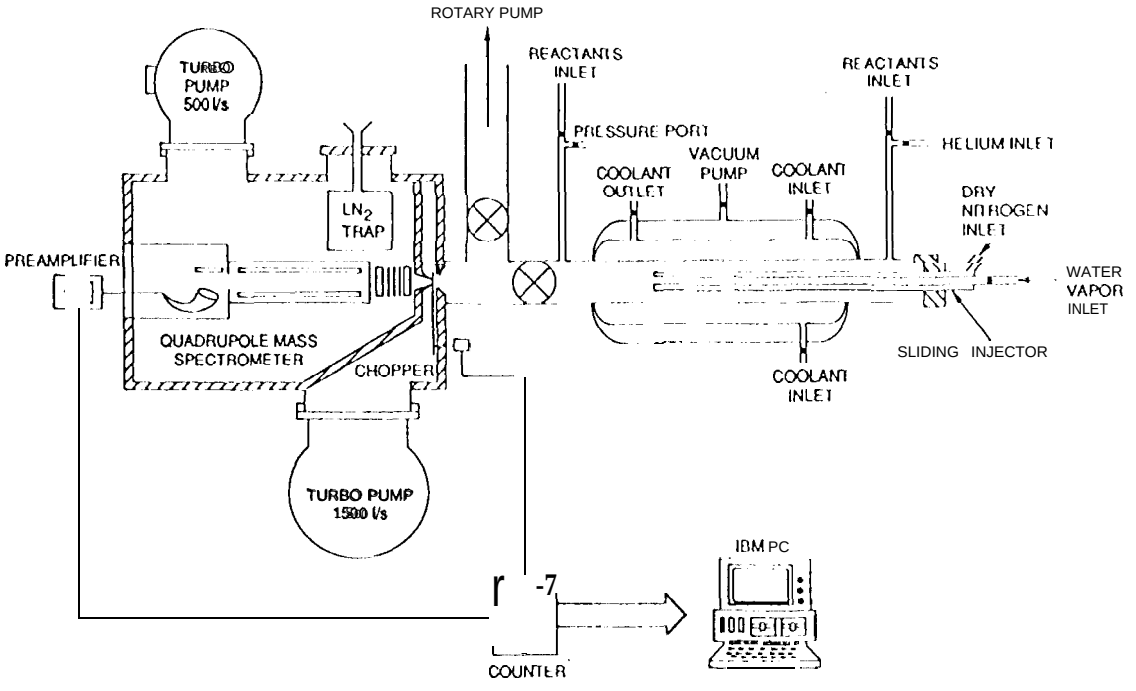

Figure 1. Schematic diagram of the experimental apparatus. The sliding injector was used to deposit either water ice or NAT on the wall of the flow reactor. HCI **was admitted alternately into the reactor through the reactant inlets located at the downstream and the** upstream ends **as shown. A differentially pumped quadruple mass** spectrometer **was employed as a detector for monitoring HCl,** H_2O, **and** HNO_3 **concentrations.**

Table 1. Comparison with Previous Measurements. The results of HCl uptake are expressed in units of mole fraction or molecules/cm^2.

Substrate	Investigators	HCl Uptake (mole fraction)	HCl Uptake (molecules/cm^2)	Notes
HCl/Ice	Molina et al, (1987);Wofsy et al, (1 988)	0.02-0.035		190 K, Freezing solution
	Wolff et al. (1989)	0.0018-0.009		Polycrystalline ice
	Hanson and Mauersberger (1 988,1 990)	2X10"^{5}- 1 X10-4		10-7-1 O"* torr, 200 K
	Marti et al. (1991)	<2 x 10^{-5}	<6x10^{13}	10-7-104 torr, 185 and 200 K
	Abbatt et al. (1 992)	2X10"^{5}	(1 -3)X10'5 '	(1-4)x1 0^{-6} torr, 201 K
	Hanson and Ravishankara (1992)	1.5 x 10^{-5}	5X1 0'^{4}	7X1 0^{-8}- 2X1 0^{-6} torr, 191 K
	This work	7x1 0^4-2X104	(2.1-61)x10^{13}	7x1 0^{-8} -6x10$ torr,188 and 193 K
HCl/NAT	Hanson and Mauersberger (1 988, 1990)	(3.5 - 5.0) X10-3		10^{-7} - 104, 200 K, 50-54 wt% HNO_3
	Moore et al, (1 990)	4X10^{-5}- 1,5 X1 O"'		1 o^4- 103 torr, 196 K, 42-58 wt% HNO_3
	Marti et al. (1991)	(1.5 - 5.0)X 103	(4.5 -I5)X1O"	10"7 - 10^{-6} torr, 200 K, 54 wt% HNO_3
	This work	6x10^{-6} - 1x10^{-4}	(1 .8-30)x1 0^{13}	1X1 0"^{7}- 2X104 torr, 188 K, 41-55 wt% HNO_3